A survey of Recent and fossil Cicadas (Insecta, Hemiptera–Homoptera) in Britain

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Synopsis

The current status and origin of the single extant British cicada, *Cicadetta montana* Scopoli, are discussed. An account of cicadas from the Tertiary and Mesozoic of Britain is given with an analysis of the taxonomy and morphology of the Mesozoic species. The family Cicadidae is recorded from the Mesozoic for the first time.

Introduction

This survey was prompted by an examination of specimens of cicadas amongst the British Upper Triassic collections at the Institute of Geological Sciences and the British Museum (Natural History).

Rohdendorf (1962) divided the 'infraorder Cicadomorpha' into two superfamilies, Palaeontinidea and Cicadidea. In the latter he placed three families, Prosbolidae, Cicadidae and Tettigarctidae. The Prosbolidae are known only from the Carboniferous to Triassic (Evans 1956: 196–206). The Cicadidae, which include the only British species, *Cicadetta montana* Scopoli, are widespread in the warmer parts of the world (Evans 1963) but extend into the temperate zone where they are represented by fewer species. As fossils the Cicadidae are known from the Tertiary, Zherikhin (1980) suggesting the Upper Cretaceous as the earliest record. The Tettigarctidae are common in the fossil record since the early Mesozoic and occur in the Tertiary. In contrast with the widespread distribution and numerous species of Recent Cicadidae, the only two living species of Tettigarctidae are restricted to Australia.

Recent cicadas in Britain

Cicadetta montana in Britain is restricted to a very small area in Hampshire (Grant 1972). Morley (1941) gave an account of the history and distribution of *C. montana*, stating that it has been 'in our midst since Britain's severance from the continent in Pliocene times'. He also pointed out that with its limited powers of flight it could not cross the Channel, although it is found in northern France (Villiers 1977). Grant (1972) supported the view that *C. montana* is a relict species, stating that its history in Britain 'is directly traceable to the old land continuity with Europe and ancient vegetative spread'. It is evident from recent work (Grant 1970, 1972; Morley 1941) that *C. montana* has never been a common insect and is mostly restricted to one southern county. It is not an easy insect to locate in the woods, in spite of its call, and it has been suggested that this call is inaudible to some people (Morley 1941: 54).

C. montana was first discovered in Britain in 1812 but Curtis (1832) commented that he and another well-known entomologist (Dale) searched for it without success for over 20 years before they finally rediscovered it. Buckton (1890) in his monograph on British Homoptera also commented on its local and very patchy occurrence. Both Grant and Morley dismissed as unlikely natural or accidental introduction of the cicada to Britain because of its relatively weak powers of flight, ephemeral adult life and subterranean early stages. However, the eggs of the cicada, which are inserted into the stems of woody plants, might well have been brought (accidentally) into Britain. A modern parallel can be drawn from the homopteran

Graphocephala fennahi Young which was first recorded in Britain in 1936 as an introduction (under the name *C. coccinea* Forster). This species lays its eggs in the sepals of rhododendron (Morcos 1953).

Morley's (1941) suggestion of the Pliocene for the origin of the British cicadas is unacceptable since it implies that this warm-loving species had survived several glacial periods in Britain. Grant's (1972) suggestion of an origin during the Boreal age (Flandrian, *c.* 7000 years B.P.) is more plausible, but I believe that if cicadas were present prior to the early 1800s then some folk-lore or published account of this large and relatively noisy insect would have appeared. However, if the 'little ice-age' from the 15th–18th century had reduced the population to a very low level it could well have been overlooked. Thus while it is generally accepted that the cicada in Britain is a relict species the possibility of its being an introduction should not be ruled out.

Fossil cicadas in Britain

The first fossil cicadas were found in Britain nearly 150 years ago but the inadequate descriptions and figures that were published led Handlirsch (1906–08) to consider that they were incorrectly identified. Fossil cicadas are known from the Eocene and Upper Triassic in Britain.

Eocene

The specimen of cicada described from the British Eocene is of considerable palaeogeographic interest and consists of one incomplete hindwing from the Isle of Mull, Scotland (Zeuner 1941: 88; 1944). It was described as *Eotettigarcta scotica* by Zeuner (1944: 110) (Fig. 1), who compared it with Recent *Tettigarcta* (Tettigarctidae) from Australia. While not congeneric, he regarded it as 'very closely related'. (Living Tettigarctidae are restricted to Australia, where the species are associated with an alpine environment, although fossil representatives of the family are much more widespread; Woodward *et al.* 1970). I have re-examined the holotype (In.38883) and have no reason to doubt Zeuner's classification of the fossil on the evidence available. Species of Tettigarctidae have been described from the Triassic and Jurassic of Asia.

Triassic

Several specimens from south-west England were described and figured by Brodie (1845) but only one species, *C. murchisoni*, was named. I have re-examined Brodie's specimens and have additional material from the Upper Triassic.

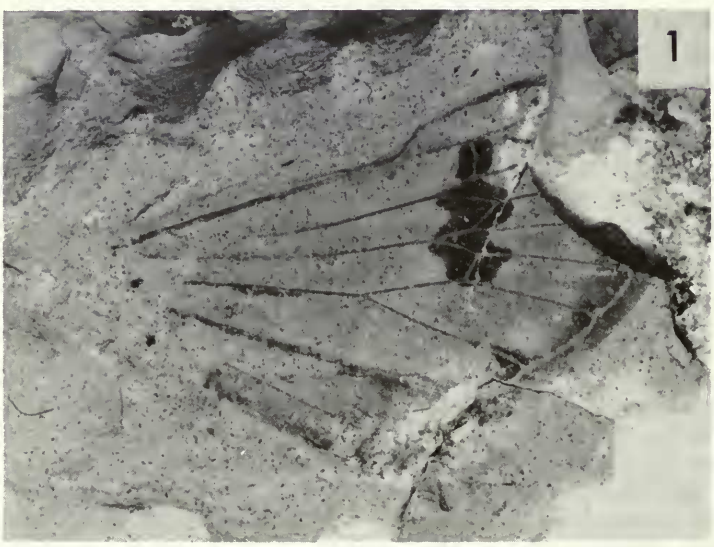


Fig. 1 *Eotettigarcta scotica* Zeuner, holotype. Isle of Mull. In.38883, BM(NH).

The generic classification of Mesozoic cicadas is based entirely on forewing venation (Rohdendorf 1962), making comparison virtually impossible with the incompletely preserved wings of British fossils. All previously described cicadas from the Mesozoic have been placed in the family Tettigarctidae but the character used to separate extant species of this family from the Cicadidae are rarely well-preserved. Woodward *et al.* (1970) separated Recent species of the two families on the presence or absence of tymbals on the dorsal side. However Dr J. P. Duffels (Amsterdam), after examining the specimens, pointed out that the large and separate pro- and mesonotum clearly shown in the British fossils are characteristic of the Cicadidae. The small amount of wing venation preserved also indicates this family rather than the Tettigarctidae. The Cicadidae have not previously been recorded from the Mesozoic.

The most distinctive feature of the British Triassic specimens is the extremely long rostrum. From an examination of Recent cicadas in the British Museum (Natural History) collection it is apparent that the rostrum of the fossils is proportionally longer than the rostrum of most Recent species. However, in the Recent genus *Platypleura* Amyot & Serville there is one species, *P. adouma* Distant (Fig. 4), where the rostrum is much longer than in others of the same genus. Even so, this species does not have a rostrum quite as long as in the fossils. In view of the variation in length of rostrum between species in Recent genera, the description of a new fossil genus based only on this character seems unwarranted.

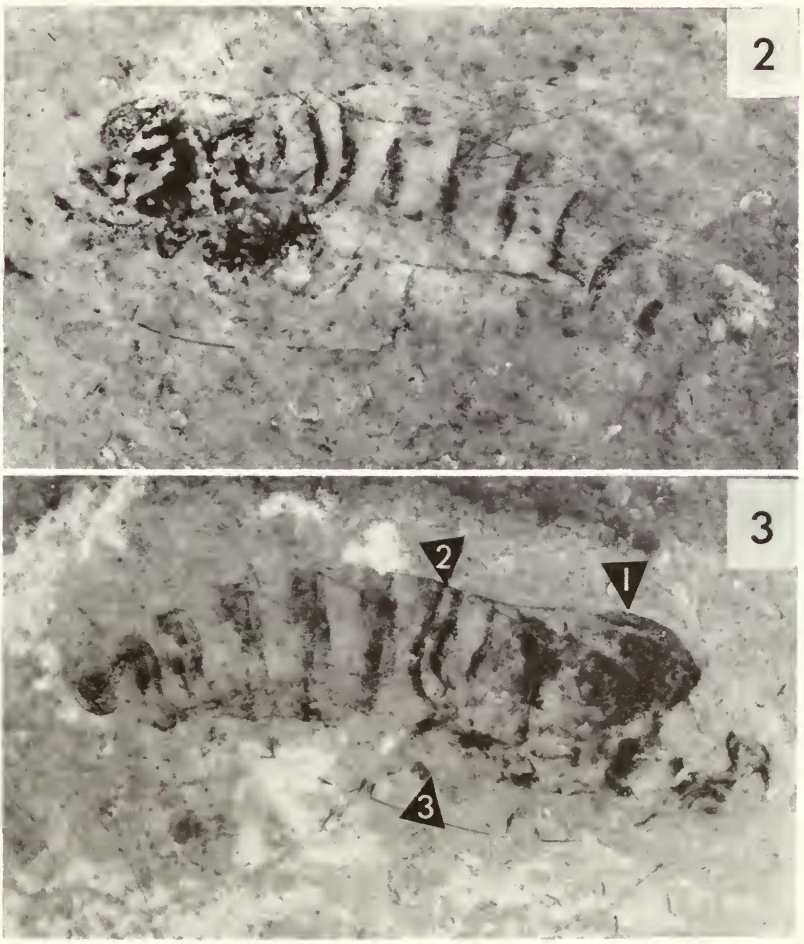


Fig. 2 *Liassocicada ignotatus* Brodie, holotype, ♂. Gloucestershire (Forthampton). In.3539, BM(NH)

Fig. 3 *L. ignotatus*. Worcestershire (Strensham). In.10449, BM(NH). suggested nymphal stage. 1 – possible emergence of imago. 2 – parallel, narrow sclerotized tergites. 3–nymphal wing-pad.

Bode (1953) based the genus *Liassocicada* on the fragment of a forewing from the Upper Lias of Germany, placing it in the Cicadidae. Rohdendorf (1962) more correctly considered it as Cicadoidea *insertae sedis* since none of the characters used to define the family are preserved in the type specimen of *Liassocicada*. However, I propose to redefine this genus and to place the British species in it provisionally.

Systematic description

Family **CICADIDAE** Leach, 1815

Genus ***LIASSOCICADA*** Bode, 1953

TYPE SPECIES. *Liassocicada antecedens* Bode, by monotypy. Jurassic.

Because the definition of this genus is based on a fragment of the forewing it is re-defined here to include *L. ignotatus* Brodie (below).

DIAGNOSIS. Cicadas with elongate rostrum reaching well down the abdomen.

RANGE. Triassic–Jurassic.

Liassocicada ignotatus (Brodie) comb. n.
Figs 2–3, 5–11

1845 *Asilus* (?) *ignotatus* Brodie: 102 [described in the Order Diptera].
1845 *Cicada murchisoni* Brodie: 101; **syn. n.**
1873 Cicada larva, Brodie: 25.
1873 Cicada pupa, Brodie: 25.

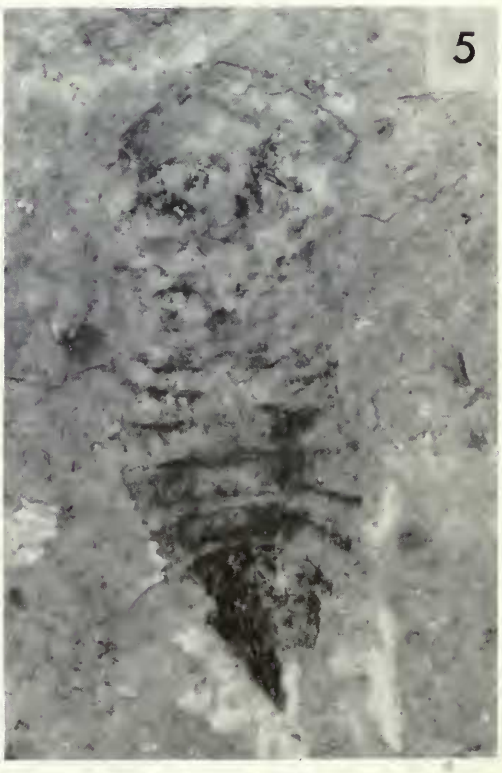


Fig. 4 *Platypleura adouma* Distant, ♀. Recent Africa. BM(NH).
Fig. 5 *L. ignotatus*. Locality unknown. In.59079, BM(NH).

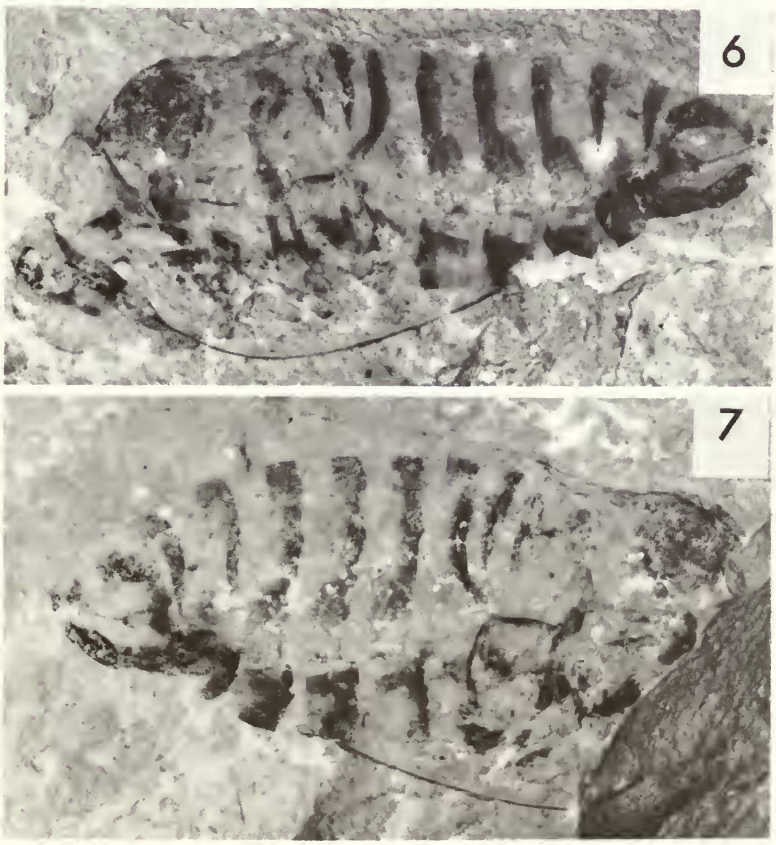
1906 *Asilus* (?) *ignotatus* Brodie; Handlirsch: 503.
1906 *Cicada murchisoni* Brodie; Handlirsch: 504.
1906 Cicada larva, Handlirsch: 511.
1906 Cicada pupa, Handlirsch: 511.

DIAGNOSIS. As genus.

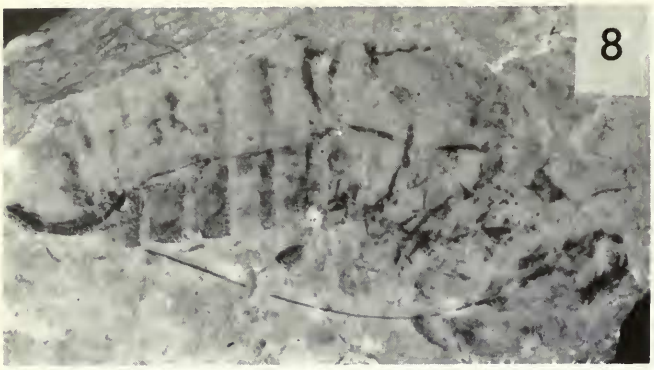
DESCRIPTION. Head with prominent, ridged frons. Eyes large, oval. Rostrum very long, reaching to base of ovipositor in female. Pro- and mesonotum large and separate. Fore tarsal segments rounded, several long spurs on hind tibia. Tympanal organ possibly represented by sclerotization at ventral side of first abdominal segment. Ovipositor short, curved and strongly sclerotized, with sclerotized (?) spermatheca preserved in some specimens (Fig. 10). Specimen In.3539 (Fig. 2) is probably a male, having a rather truncate tip to the abdomen and more slender body than the females. Traces of wing venation are also present on this specimen. Specimen In.10449 (Fig. 3) is probably a nymph, showing the split along the dorsal side of the thorax with (?) partially emerged adult (Fig. 3, arrow 1). [Ocelli, most of wings, tymbal organs not preserved].

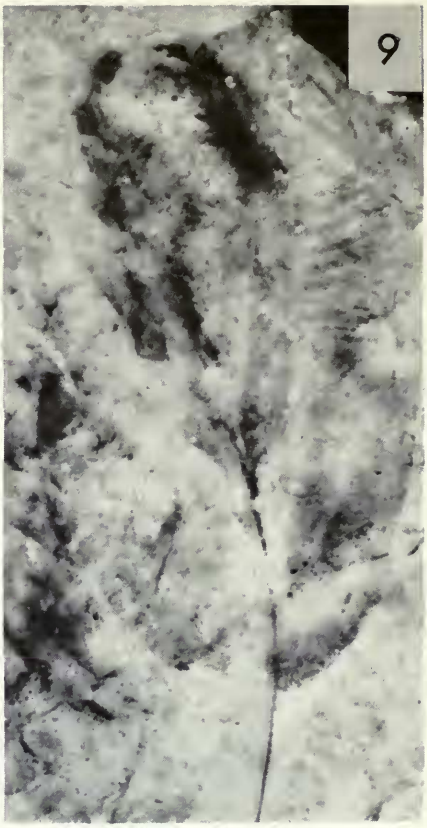
HOLOTYPE. In.3539. Forthampton, Gloucestershire; Brodie coll. in British Museum (Natural History). Fig. 2.

OTHER MATERIAL. All except the last in British Museum (Natural History) collections.
In.3537. Hasfield, Gloucestershire. Holotype of *C. murchisoni*.
In.10449. Strensham, Worcestershire. Brodie coll. Fig. 3.
In.10440. Strensham, Worcestershire. 'Cicada larva', Brodie coll.



Figs 6, 7 *L. ignotatus*. ♀ [Worcestershire], 'Lower Lias'. IGS GSb 273 (part and counterpart). Institute of Geological Sciences, Geol. Soc. coll. See also Fig. 11.





Figs 8, 9 *L. ignotatus*. Worcestershire (Strensham). In.11244, BM(NH). Fig. 9, head, stylets and ridged frons, enlarged. See also Fig. 10.

In.11113. Strensham, Worcestershire. Brodie coll.
In.11240. Strensham, Worcestershire. 'Cicada', Brodie coll.
In.11244. Strensham, Worcestershire. 'Cicada pupa', Brodie coll. Figs 8–10.
In.59079. 'Cicada pupa', Brodie coll.; locality unknown but similar in preservation and appearance to the Strensham material. Fig. 5.
IGS GSM GSb 273 [Worcestershire] 'Lower Lias' (no other details); part and counterpart. In Institute of Geological Sciences. Figs 6, 7, 11.

AGE AND DISTRIBUTION. Upper Triassic, Rhaetian Stage; Penarth Group, Lilstock Formation, Cotham Member, *Pseudomonotis* Bed (formerly an 'Insect Limestone'); north-west Gloucestershire and Worcestershire. 'Insect Limestones' have been described by several authors from exposures in Somerset, Avon, Gloucestershire, Worcestershire and Warwickshire, and they are not all at the same horizon. The Insect Limestone in the Tewkesbury and Upton-upon-Severn area from which the cicadas described here were obtained is better called the *Pseudomonotis* Bed, in order to distinguish it from similar beds in other areas which may belong to different horizons. Brodie (1845: 100–102), and more recently Richardson (1948: 143–144; 1966: 153), stated that the bed belonged to the Lower Lias, but most other authorities agree that it was one of the top layers of the 'Rhaetic Beds' (Wright 1878: 14; Richardson 1903: 127–174; 1904: 22, 207–210; Arkell 1933: 107). The confused stratigraphical nomenclature and doubts about its Triassic or Jurassic age have been superseded by the Geological Society's detailed correlations of the British Triassic (Warrington *et al.* 1980) and Jurassic Systems (Cope *et al.* 1981). In the latter report the base of the Jurassic is drawn at the horizon of the first appearance of *Psiloceras planorbis*, and all lower beds (including the lowest part of the 'Liassic Series') belong to the Triassic System. So the *Pseudomonotis* Bed is now firmly established as of Triassic, Rhaetian Stage, age.

DIMENSIONS. Body length 20–25 mm, males smaller than females.

DISCUSSION. Although the name *murchisoni* has page priority over *ignotatus*, and was recognized as hemipterous by Brodie while *ignotatus* was considered dipterous, the holotype of *murchisoni* (In.3537) is not well preserved. Unless the specimen was formerly more complete it is difficult to see why it was considered a cicada. Nothing on it actually rules it out as a cicada but equally only the incompletely preserved forelegs suggest that it might be one: *murchisoni* is here considered a *nomen dubium*. The specimen described as *A. ignotatus* (Fig. 2) by Brodie has the long rostrum characteristic of the other specimens (Figs 3, 6, 7) and is chosen in preference to *murchisoni*.

Dr J. P. Duffels has suggested that In.10449 (Fig. 3) is a nymphal stage, possibly with the emerging adult (arrow 1). There are two parallel sclerites (arrow 2) which are typical of nymphal

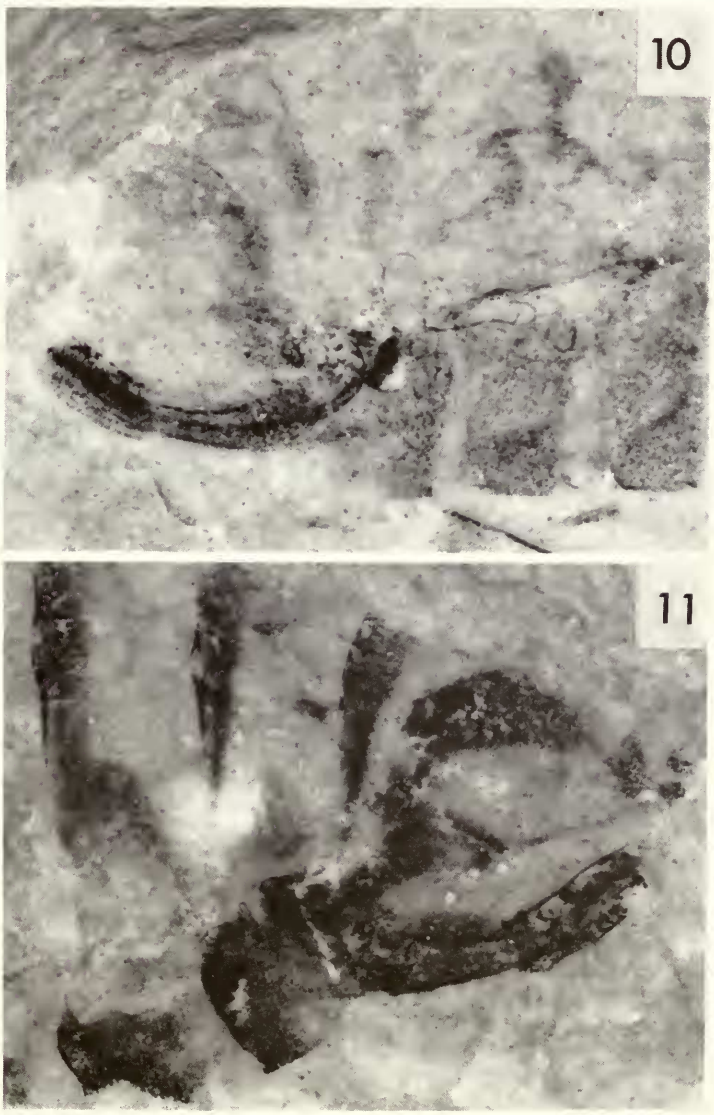


Fig. 10 *L. ignotatus*. Worcestershire (Strensham). In.11244, BM(NH). Ovipositor valves, enlarged. See also Figs 8, 9.

Fig. 11 *L. ignotatus*. ♀ [Worcestershire], 'Lower Lias'. IGS GSb 273, ovipositor valves, enlarged. Institute of Geological Sciences, Geol. Soc. coll. See also Figs 6, 7.

cicadas. The separation of the three thoracic segments is also more clearly shown, suggesting a nymphal instar, and possible wing pads (arrow 3) are indicated. All the other specimens have traces of wings or ovipositors, indicating that they were adults. Cicada nymphs are subterranean with the last instar coming to the surface to moult to the adult stage.

The ovipositor and associated structures are well preserved in most specimens, suggesting a typical strong, slightly curved cicada-type capable of inserting eggs into woody plant tissue. In two specimens (Figs 8, 10) there are associated structures at the base of the ovipositors which may represent the spermatheca but could even have been eggs. Probably the most remarkable structure of the British Mesozoic cicadas is the long rostrum which was at least 14 mm long and in the female reached the base of the ovipositors. The structures actually preserved are the stylets, the elongate maxillae and mandibles with only parts of the surrounding rostrum preserved in a few places. There is no evidence that the stylets were coiled up inside the head capsule, and comparing it with the Recent species (Fig. 4) where the rostrum is also long, it was probably held between the legs. With the humped thorax and typical adpressed head, the method by which the stylets were inserted into the plant tissue is interesting. Aphids with long stylets tend to feed on fissured bark of tree trunks or large roots (Dr V. F. Eastop, personal communication), but it is difficult to see how the Triassic cicadas could insert the long stylets into a plant using the technique of Recent, short-rostrum cicadas. It is possible that its length was important in probing down packed leaf-buds or scales to get at the tissue these were protecting, for example to get at the embryo deep between the scales of a *Pinus*-type cone. It is also possible that the stylets were inserted into plant tissue, but in the absence of evidence from the feeding behaviour of Recent species no further light can be thrown on this remarkable structure.

Acknowledgements

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References

Arkell, W. J. 1933. *The Jurassic System in Great Britain*. 684 pp. Oxford.

Bode, A. 1953. Die Insektenfauna des ostniedersächsischen Oberen Lias. *Palaeontographica*, Stuttgart, (A) **103** (1–4): 1–375.

Brodie, P. B. 1845. *A history of the fossil insects in the Secondary rocks of England*. 130 pp., 11 pls. London.

—— 1873. The distribution and correlation of fossil insects and supposed occurrence of Lepidoptera and Arachnidae in British and Foreign strata, chiefly in secondary rocks. *Rep. Warwicksh. nat. Hist. archaeol. Soc.*, **37:** 12–28.

Buckton, G. B. 1890. *Monograph of the British Cicadae or Tettigidae,* **1**. 134 pp., 3 + 38 pls col., London.

Cope, J. C. W. *et al.* 1981. A correlation of Jurassic rocks in the British Isles. Part I. *Spec. Rep. geol. Soc. Lond.* **14.** 73 pp.

Curtis, J. 1832. *British Entomology* (&c.), **9:** 386–433. London.

Evans, J. W. 1956. Palaeozoic and Mesozoic Hemiptera (Insecta). *Aust. J. Zool.*, Melbourne, **4:** 165–258.

—— 1963. The phylogeny of the Homoptera. *A. Rev. Eht.*, Palo Alto, **8:** 77–94.

Grant, P. J. 1970. Search for our insect singers. *Countryside,* London, (NS) **21:** 301–307.

—— 1972. Conserving Britain's cicadas. *Countryside,* London, (NS) **22:** 8–11.

Handlirsch, A. 1906–08. *Die fossilen Insekten und die Phylogenie der rezenten Formen*. 1430 pp. Leipzig.

Morcos, G. 1953. The biology of some Hemiptera–Homoptera (Auchenorryncha). *Bull. Soc. Fouad I. Ent.*, Cairo, **34:** 405–409.

Morley, C. 1941. The history of *Cicadetta montana* in Britain, 1812–1940. *Entomologist's mon. Mag.*, London, **77:** 41–56.

Richardson, L. 1903. The Rhætic rocks of North-west Gloucestershire. *Proc. Cotteswold Nat. Fld Club,* London, **14** (2): 127–174.

—— 1904. *A handbook to the Geology of Cheltenham and Neighbourhood*. 303 pp. Cheltenham.
—— 1948. The upper limit of the Rhaetic series and the relationship of the Rhaetic and Liassic series. *Proc. Cotteswold Nat. Fld Club*, London, **29:** 143–144.
—— 1966. The upper limit of the Rhaetic series and the relationship of the Rhaetic and Liassic series: a correction. *Proc. Cotteswold Nat. Fld Club*, London, **34** (3): 153.
Rohdendorf, B. B. 1962. [Arthropoda. Tracheata and Chelicerata.] *Osnovy Paleontologii*, Moscow, **9.** 560 pp. [In Russian].
Villiers, A. 1977. *Atlas des Hémiptères* (nouv. edn). 301 pp., 24 pls col. Paris.
Warrington, G. *et al.* 1980. A correlation of Triassic Rocks in the British Isles. *Spec. Rep. geol. Soc. Lond.* **13.** 78 pp.
Woodward, T. E., Evans, J. & Eastop, V. F. 1970. Part 26, Hemiptera. *In: Insects of Australia:* 387–457. Canberra, C.S.I.R.O.
Wright, T. 1878–86. Monograph on the Lias Ammonites of the British Islands. 503 pp., 88 pls. *Palaeontogr. Soc. (Monogr.),* London.
Zeuner, F. E. 1941. The Eocene insects of the Ardtun Beds, Isle of Mull, Scotland. *Ann. Mag. nat. Hist.*, London, (11) **7:** 82–100.
—— 1944. Notes on Eocene Homoptera from the Isle of Mull, Scotland. *Ann. Mag. nat. Hist.*, London, (11) **11:** 110–117.
Zherikhin, V. V. 1980. Class Insecta. *In* Menner, V. V. (ed.), [Development and change of Invertebrates on the border between the Mesozoic and Caenozoic . . .]: 40–97. Moscow, Paleontologicheskii Institut, Akademiya Nauk SSSR. [In Russian].